LETTERS TO THE EDITOR.

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Heights of Sunset After-glows in June, 1902

THERE was a very fine example of red sunset after-glow visible here on the evening of the 26th ult., which presented with rather remarkable appropriateness to the date of its appearance, as immediately occurred to me while watching the impressive sight, a scene of transcending splendour of nature's own elaboration which could hardly have been much surpassed in grandeur by what England's great display of rare illuminations on that night would undoubtedly have been, if a check most sorely sad and grievous had not interposed a throb of deep sorrow on the nation, eliciting good proofs of its heartfelt sympathy and loyalty so universally and strongly as to prevent those sumptuous light displays from being used as auspiciously as they were hoped to be to celebrate the joyfully expected "Coronation-day" of 1902. The sun set at about 8h. 25m. with its orange-yellow disc unhazed, and only shorn of rays by a few faint cirrus cloud-streaks close to the horizon, the sky being elsewhere apparently quite free from clouds. At about 8h. 40m. a long low belt of sky extending 70° or 80° along the north-west horizon had grown orange-yellow, streaked with a few faint lines of red and gradually diluted upwards at a height of 15° or 20° into pale shades of light yellow. A ruddiness of the sky in the east had at the same time risen nearly to the zenith, and through its natural blue tint there the sky passed gradually to white about half-way from the zenith to the west horizon, while under this white tract (about 30° in width) lay the bright belt of orange light with its shades of yellow gradually deepening downwards. But at about 8h. 45–50m. the pure white interval between the ordinary blue and the yellow-tinted regions was gradually invaded, and at last quite occupied, by the advancing ruddy colour from the east; and until about 8h. 55m. a space from 30° of altitude in north-west to near and somewhat beyond the zenith, and for 40° or 50° to either side of a vertical line through the place of sunset, presented a broad expanse of rich rose-coloured, lake-red light pervading all the sky's north-western quarter with a fine wide blaze, against the purple glare of which tall trees and houses all looked sharply silhouetted, and for a short space of about ten minutes that the rose-red colour lasted, all objects of the landscape facing towards the west looked conspicuously crimsoned. The ruby-tinted glow sank rather rapidly in height, and by 9 p.m. it had subsided into the summit of a lower and far brighter pinkish-orange bank of light about 30° high, the lower layers of which formed a belt 12° or 15° in height stretching for about 90° along the west-to-north horizon in a blaze of yellow amber or of ochre-yellow colour. No radiating streamers or shadow-beams crossed either the previous purple glow or this orange-reddish, dome-like bank of light; but the latter light-field's splendid flood of unflecked, evenly-spread colour sank very gradually, preserving its length, to 12° or 15° in altitude by 9h. 15m., growing less ruddy, and assuming pretty uniformly then throughout the horizon layer's yellow-ochre colour. As its brightness had then very sensibly diminished, no further watch was kept on its later changes of appearance.

The time of occurrence of the true rose-tinted glow, when the white space's illumination was replaced, and then swept down into the sunset-glow, by a westward coursing wave apparently, of rose-tinted light, was about 8h. 50–55m. when at its brightest, or about 25–30m. after sunset, when the sun was therefore about 3° below the horizon here, and when the earth's shadow-surface cast by the sun through the air above this point of view was about five miles from the earth's surface. The finely divided matter which by a red-bordered coronal or "Bishop's ring" effect[1] of diffraction, probably, on an exceedingly wide-circle scale, bent downwards into view from nearly overhead the sun's parting rays in the westward coursing way which seems to be quite general in these dust-caused colour-glows, and with red colour made rosy, probably, by mixture with the sky's ordinary blue, must thus, it appears, have been at no very considerably greater height in the atmosphere than about five miles; or at about the ordinary floating level of cirrocumulus and cirrostratus clouds.

A few less radiant after-glows of rosy tinge appeared here when the sky was clear, on June 17 and 21; but no perceptible traces of rose colour occurred in the pallid sunsets of June 23 and 25, although the sun went down on the latter date behind a faint low bank of cirrus cloud, surrounded by a splendid orange-yellow "glory" about 10° wide, very suggestive of "Bishop's ring," as it was shaded off by redder colour at its borders. As the last visible spark of the sun's bright orange body disappeared in a little cleft, apparently (for it lingered there for a second or two), of a tree-clad hill horizon four or five miles distant, it was white (and the same was noted on the 26th), and showed no greenish coloration.[1] Under the north-western edge of a thick cloud-veil which overspread the sky on Sunday evening, June 22, a belt of sky about 40° long and about 10°–15° high was brilliantly ablaze, from 9h. to 9h. 15m., with light of orange-yellow colour slightly streaked with red, and presented, among fragments of dark cloud dispersed across it, an almost terrifying resemblance to reflection in the sky of an immense distant conflagration. On June 24 a ruddy yellow glare widely pervaded the clear sky to a high altitude in N.W. from 8h. to 8h. 30m., but I was not fortunate enough among obstructions of its view in London to obtain any observations of its changes. On two other evenings, however, Friday and Saturday, June 27 and 28, sufficiently clear views of the rose-tint were seen, the times of apparition of which were recorded, to afford additional determinations of the real height of its appearance; and the following are some details of the pink glow's aspect on the three or four dates besides June 26 when its successive changes here were pretty clearly recognised and were approximately noted.

On June 17, the first clear evening after a cold, rainy fortnight, a pale cochineal tint, in the north-west, of the beautifully transparent sky was first quite plainly noticed, at 9h. 10–15m., of some width and at an altitude of about 10°–30°; although a similar, but rather weaker, pink glow had already before been seen with rather less distinctness on the last two nights of May; and on this evening it faded out by 9h. 15m., sinking down into a brick-red light-glare 5°–10° high, which by about 9h. 20–25m. grew dull orange-yellow and then faded. The first commencement of the glow was not seen, but as it was probably near its brightest at 9h. 10m., 45 or 50m. after sunset, when the sun would be 5⅔° below the horizon, its real height above the earth, making proper allowance for its low altitude of 20° and for the sunlight's refraction, was about 13 miles; while its low angular distance from the sun probably denoted a not very excessive fineness of the sunlit haze material.

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[1] The ring was thus described by Mr. S. E. Bishop, at Honolulu, in NATURE (vol. xxix. p. 260, 1884, January 17):—As "a very peculiar corona or halo extending from 20° to 30° from the sun, which has been visible every day with us, and all day, of whitish haze with *pinkish* tint shading off into *lilac* or purple against the blue . . . It is hardly a conspicuous object." In the growing dusk, however, of an hour after sunset, the ring of pinkish white and purple, probably produced by admixture of the sky's ordinary blue with the yellow, orange and red parts of a pure corona, however weakly visible in full daylight, might yet in twilight look bright enough to be easily distinguishable; and the gradual shrinking inwards of this distinct red bordered ring from nearly overhead towards the west as the remaining upper levels of the atmosphere still lighted by the sun's rays grow every moment loftier, must pretty surely indicate that the first red light to fade away, or that beginning nearly overhead and furthest from the sun, belongs at once to both the lowest and the finest-grained dust-layers of the corona-forming haze; a conclusion nowise inconsistent with a usually experienced property of mists that they most commonly become coarser-grained in retreating inwards from their borders.

[1] The earliest mention that I have seen of the "green-flash" at sunset, as having been sometimes observed on the sea horizon from Bude, in Cornwall, by the Rev. G. H. Hopkins (NATURE, vol. xxix. p. 7, 1883, November 1), concludes with a remark that the effect was not produced when the sun set behind a distant cloud, and that it might very probably be also seen at sunrise. This last conjecture was immediately confirmed (*ibid.*, p. 76) by Prof. W. Swan, who wrote from Edinburgh that when watching for sunrise on the Rigi, on the very clear morning of September 13, 1865, he saw the sun appear with a dazzling blaze, for the first instant, of superb emerald green colour, from behind the sharp outline of a distant mountain. It may be interesting to add here, with respect to the other condition noticed by Mr. Hopkins, of the green flash not being apparently produced by the sun's descent behind a cloud, that having been myself, with three others (two of us using binocular field-glasses), well placed on April 22 last for trying to observe the totally eclipsed moon in the east and the setting sun in the west above the horizon together, the sun at least, after a cloudy and rather stormy day, set in an opening of clear sky, behind a low bank about 2° or 3° high, of sharply edged, opaque and solid-looking cumulus which, judging from the ten miles distant ridge of hills at Cookham, very far behind which the cloud-bank seemed to lie, could hardly have been less than 20 or 30 miles from our position. Passing the word to "look out for colour," when the sun's upper limb was nearly disappearing, we all exclaimed "green!" together, as the last and most northerly light-speck of three bright beads into which the sun's upper limb broke up at last lingered for not much more than half a second after the other two, both of which looked rather whiter than the last, when fading, and then vanished. Of the last spark's distinctly green colour there could be no doubt, and it inclined rather to a yellowish than to a blue shade of green. A thin thread of yellow light, like an extremely slender, short, crooked horizontal lightning flash, fringed the dark cloud's upper edge for a few minutes, behind which, at about 7h. 15m., the sun had descended; and beyond that the clear sky was nearly grey, and until about 7h. 30m., like the sun's disc itself, very free from yellow and orange sunset colours.

On June 21, at 8h. 53–56m., or about 30m. after sunset, a wide expanse of pink glow was seen in the upper parts of three broad streamers radiating not far from vertically upwards, to altitudes of about 30°, from the sun's place. The streamers sank in altitude to about 20° by 9h., and subsided gradually by about 9h. 5m. into the summit of a ruddy yellow light belt extending about 90° along the horizon in the sunset quarter to altitudes of 8°–15°. This bright tract grew duller yellow and orange at its base and borders, until about 9h. 20–25m., when it had nearly faded out. At 30–35m. after sunset, when the streamers' crests at an altitude of 20–30° glowed visibly with rosy light, the sun was 3½° or 4° below the horizon here, and the height of the red coronal glow produced there by the sun's parting rays must have been about 6½–8½ miles above the earth.

For nearly half an hour after sunset on June 27, the clear north-western sky showed only weak dull shades of yellow, but a long low belt of this at the horizon attained some intensity at 8h. 45–50m., when a short arched band of level cloud streaks grew pink at first and then bright crimson on their lower edges, and from 8h. 50m. to 9h. presented there a splendid interlacing network of red stripes about 35° long and 4° high. At the latter hour pink streamers radiating from the hidden sun as centre and springing chiefly from the northern upper portion of the yellow light belt began to be visible, two immensely long and very narrow straight ones leaving it at about N.N.W., altitude 8°, with slopes of 15°–20° from horizontal, and reaching out, 3° or 4° apart, through 53° or 60° to somewhat beyond N.N.E., ending at altitudes there of 15°–20°. The upper and stronger one was pink towards its end, but where they joined the light belt most brightly, and passed through north at altitudes of about 10°–12°, they partook of the light belt's reddish yellow colour; above them some much shorter and weaker pinkish streamers soon appeared, and at about 9h. 15m. two rather tall wide patches of faint rosy pink were formed at an altitude of 25° or 30° above the sunset place, by two nearly vertical wide streamers, and remained visible with pink colour for some minutes. While travelling here by train from London during its appearance, I could not note the early stages of this glow's commencement, and my whole view of it was very partial; but from the pink tint's visibility from 9h. to 9h. 15m. at an altitude of about 20°–30°, at about 40 or 50m. after sunset here, when the sun was 4¾°–6° below the horizon, the heights of the pink crests of the radiating streamers would seem to have been, not very accurately, about 12½–20 miles above the earth.

A most complete view, however, of the successive features of the purple glow was obtained here on the evening of Saturday, June 28, when the concluded height of its appearance so surprised me by its unexpected lowness as to lead me to examine also the foregoing observations with a view to a general comparison together of the glow's real heights that would be found to be derived from my notes of it on different evenings. The sky was then streaked with cirrostratus cloud-seams ruling it with fan-like convergence towards about the sunset quarter; but except in that direction those fleecy stripes dispersed by about 8h. 40m., and the nearly clear north-western sky half-way to the zenith was pale yellow, passing above about that altitude into greyish white, and beyond the zenith into blue. At 8h. 50–53m., the yellow sky-zone's colour having deepened and the grey-white tract above having descended to about altitude 40°–45°, the latter space grew rapidly rose-pink and round its centre a nearly circular field about 40° in diameter displayed pale pink oleander-flower or almond-blossom colour. Ending upwards, under this, in light straw-yellow, lay the wide-arched summit of a pretty strong horizon glow about 20° high over the sun's place and about 30° long in span to either side of it, of ochre-tinted yellow. The rose-pink coloured space sank gradually, or died out from above, between 8h. 55m. and 9h., replaced from behind by greyish and blue sky and invading the pale straw-yellow summit of the arched horizon-glow, which together with that whole glow, by about 9h. 5m., grew orange-red throughout. This litharge-red, and a little while later fan-tail-looking, glow contracted slowly downwards until 9h. 15m., when as it was growing dim and inconspicuous I ceased to watch it. But in the last 10m. its upper border had in its usual way, when beginning to grow red, broken up into bright radial streamers crossing what remained visible of the cirrus streaks at such appreciable angles as to show them to be true solar light-beams quite unconnected with the wind-imparted radiation of those cloud-streaks from a near neighbouring but different focal centre. Where a long and well-defined straight radial streamer shooting up obliquely southwards crossed some of those faint cloud-streaks' strongest ripples, their gauzy cloud materials certainly did not add to its brightness; but at the same time they diminished the streamer's light so much less than that of the grey sky immediately adjoining it, that they could hardly be said to have very distinctly screened and darkened it.

As the sun's parting illumination of the sky with rosy colour, from altitude about 50°–60°, downwards, in this sunset, occurred (at about 8h. 55m.) not much more than 30m. after sunset here, when the sun was 3½° below the horizon, it would follow that this red illumination by direct sunbeams, of microscopically fine haze matter took place at about 7½ miles above the earth, or apparently not far from about the probable real heights of the simultaneously noticed cirrostratus cloud-streaks.

The chief features of these recent after-glows having been just the same as those which were generally noticed during the gradual subsidence of the volcanic after-glow appearances in 1883–4, since it was then pointed out by some investigators of their real heights that some white cloud-wisps looking phosphorescently bright long after dark, and even sometimes, near the horizon in the north, throughout the night, must have been floating far above the ordinary height limits of rain and snow clouds produced by aqueous vapour, I was led by the comparative lowness of these few new height conclusions to consult the original accounts given in NATURE by many good observers of the sky-glows in 1883–4, to recall more exactly than I could certainly remember what real heights had then been actually assigned to them. In such letters as Mr. F. A. R. Russell's, at Haslemere (NATURE, vol. xxix. p. 55), describing the evening sky-glow on November 9, 1883, as having twice pervaded the sky with rosy red, beginning from overhead, first at 5h. and again at 5h. 40m. (or at 42m. and at 1h. 22m. after sunset at 4h. 18m.), and as having gradually settled down into the greenish-yellow glare at the horizon in about 20–25m., it is quite evident that much loftier heights of the pink glow were then indicated than those which have just now again been essayed to be determined. The sun, at these two glows' commencements, would be about 5¾° and 11½° below the Haslemere horizon, and the corresponding vertical heights over Haslemere of its earth-grazing beams would, allowing about ½° for their downward deflection by refraction, be about 17 and 75 miles above the earth.

In letters from Mr. J. E. Clark at York and from Mr. J. Ll. Bozward at Worcester (*ibid.*, pp. 130–131), the sky-glows from November 27 to December 4, 1883, were similarly described, in general, as usually attaining their strongest and brightest redness about one hour after the time of sunset, with durations afterwards of the fiery-looking dying-out phase of the glow for nearly an hour longer. Although these observations were not made with certain enough discrimination of the exact times of the rose-red tints' commencements to afford very definite determinations of their real heights, yet in their records of about one hour after sunset, at which the whole height and width of the sky assumed an especially imposing kind of red magnificence, they were for the most part pretty perfectly accordant. At an hour after sunset on December 1, the sun would have sunk about 7° below the horizons of York and Worcester, and the height above the earth of fine dust-haze beginning to shine then overhead with red illumination would be about 25 miles. But determinations of the pink glow's real height by the method which has here been used, and of the warrantableness of which the roseate displays' frequent collection into tufted heads of real sheaf-like sunbeam radiations is itself a sufficient proof to afford us full assurance, were in fact actually obtained on November 25–26 and 29, 1883, and were communicated in letters (*ibid.*, p. 103 and p. 130) by Annie Ley, at Ashby Parva, Leicestershire, and by R. von Helmholtz, in Berlin, who concluded it to have been at upwards of 13 and at about 40 (? more nearly 30) miles high respectively. The intervals after sunset when the wide red glow began in these two latter cases were about 50–60m. and a little more than one hour, resembling the generality of other observers' records, in those most gorgeously coloured, long-enduring sunsets, of the times of the conspicuous red glows' commencements; but this average interval appreciably surpassed the shorter space of 25-50m. (as did also the fading out duration of nearly an hour exceed that of only 20-25m.) observed in last month's displays; and the computed heights accordingly of the glow-producing matter ranged considerably lower (from 5 or 8 to 13 or 20 miles) in these latter than in the memorable sunset glows which followed the great eruption in Java on August 27, 1883, when heights appear to have been found of 13 or 17 to 25 or 30, or even possibly of 40 or 70 miles, for the strata of the atmosphere contaminated with volcanic dust.

The relative height results and the comparative intensities of the present and of the former glow displays seem, however, to have been in quite naturally comprehensible agreement with the lower height of projection, and with the generally lesser magnitude of the recent fearfully destructive outburst on the islands of Martinique and St. Vincent, when compared with the terrifically violent and immense volcanic explosion of Krakatoa in August, 1883, which is generally admitted to have had no previous parallel, in respect of scale and violence of mountain-mass ejection, in the history of such terrestrial convulsions. It will be interesting to notice on future nights if more examples of rose-red coloration should occur, when the times of the white and yellow sky-tracts becoming pink and ruddy should be noted, as the past month's rosy and fire-tinted sunsets were perhaps not quite sufficiently conspicuous to establish their certain connection with the terrible volcanic catastrophe of May 7-8 last in the West Indies. But considering the low temperature and continued cold soaking rainfall during all the early part of last month, until Sunday, June 22, it seems far from easy to conceive that the strikingly fine sunset display of Thursday, June 26, and the conspicuously rosy colorations of the sunset sky on June 27 and 28 can by any possibility have been merely sunset glares produced by ordinary floating dust raised locally from parched or arid tracts of land by the heat and fresh east wind of those few days of the first short interval of summer warmth and sunshine in last month, on which they were observed.

Observatory House, Slough, July 10. A. S. HERSCHEL.

P.S.—July 16.—A very fine display of orange-reddish streamers diverging in an open fan of six or seven stately light-beams from a similarly coloured horizon glow, 6° or 8° high at their common base where the sun had set (at about 8h. 15m.), was seen here on Monday evening, July 7. From 8h. 50-55m., when these fiery looking beams began to appear, up to altitudes of about 35°, across a rosy tract of sky which had sunk to the elevation of their growing crests from a higher region of pink colour first distinctly well perceived at 8h. 42-44m., their radiant light-sheaves shortened gradually without change of place or brightness; and they lasted thus quite 20m., retreating slowly into the decreasing glow at the horizon until that glow itself, at last, grew quite low and dull at 9h. 15m. The pink glow's lower border, when the first bands of streamers crossed it, was not more than 10° or 12° from the horizon, and the glow's red hue soon permeated all the yellow belt of sky which lay below it, while the streamers, at their heads, grew orange-red in place of pink, and thus from 8h. 50-55m. onwards, the whole display, until it subsided, was of one bright pinkish-orange tint in all its features. The new moon's very slender crescent, at 8h. 55m., lay less than 1° from the horizon, under the end part of the most southern streamer, looking pure yellow, and showed by its clear visibility how free from mist and smoky haze the sky was on that evening quite close to the horizon.

From the pink glow's first appearance at 8h. 43m, with an altitude of about 35°, at about 28m. after sunset, the resulting real height of the layer of dusty air which was thus lit up by the sun's departing rays, could not much exceed 5 miles above the earth's surface. On other dates in July before and since that notable appearance, the observed occurrences of a pink tinge in the sunset sky were scarcely noticeable, and the estimated time of its first appearance was only once thought to be pretty certainly trustworthy, on Sunday, July 13. A rosy tinge then first presented itself pretty brightly at 8h. 41m., about 33m. after sunset, at about altitude 40°, sinking down along the heads of some nearly vertical wide streamers, in three or four minutes to altitude 15°-20°, where it soon died away. The height of the mauve-coloured haze-stratum in the atmosphere which this observation pretty nearly indicated would seem to have been about 7 or 8 miles.

In addition to the above short notes of some particular accounts contained in NATURE of the bright sky-glows of November and December, 1883, it was observed, I find also, by Mr. E. Douglas Archibald, at Rusthall, near Tunbridge Wells (NATURE, vol. xxix. p. 176), that after sunset (at about 3h. 51m.) on December 6, a bright silky-looking white space in the clear sunset sky changed to pink at 4h. 25m. (34m. after) and to red at 4h. 45m. (54m. after sunset), which would imply heights of the pink and red glows of about 8 and 21 miles above the earth. But from the appearance of the glow on December 7 and of its reflection on low clouds, Mr. E. D. Archibald remarked that the red light's long continuance after the pink glow's departure was mainly attributable to cloud or haze reflections of true red coronal glares about the sun; and the conspicuous tinging of the white space with pink or rosy iridescence he concluded, from the interval between the concluding glow of ordinary cirrus and the commencing glow of the loftier dust stratum, corresponded more nearly with a height of from 10 to 13 miles, than with the great height of 40 miles assigned to the glow (probably from long-lasting reflection of red glows in the west on low-lying clouds, or perhaps even on the high dust stratum itself) by Prof. von Helmholtz.

Distribution of Pithophora.

IN your Notes of July 17 you state that Mr. Kumagusu Minakata wishes to know if any species of the genus Pithophora besides *P. Kewensis* has been reported from any part of the Old World except Japan since 1877.

P. radians, West and G. S. West, was described from Loanda, on the west coast of Africa, in *Journ. Bot.* (January, 1897, p. 36), and has more recently been found in Ceylon (cf. *Trans.* Linn. Soc., bot. ser. 2, vol. v., 1902, p. 132). *P. Reineckii*, Schmidle, was described from Samoa in Engler's *Bot. Jahrb.* (xviii., 1896). Schmidle has also described at least one other species from the Old World, but I have not the reference to hand. It will be found within the last five years either in Engler's *Bot. Jahrb.* or in "Hedwigia." G. S. WEST.

Royal Agricultural College, Cirencester, July 18.

Saturn Visible through the Cassini Division.

IN NATURE of May 22 you were good enough to publish my prediction that, on July 17, the Cassini division of Saturn's ring would be invisible where it crossed the planet.

On July 15, Mr. Townshend, president of the Leeds Astronomical Society, reports that he saw the division throughout the ring and crossing the globe, but that on the 17th the portion crossing the globe was invisible. Mr. Townshend observed with a 10-inch reflector, and is a very competent observer.

On July 17 I was observing with a 9-inch refractor, and the Cassini division, clearly seen in the ansæ of the ring, was quite invisible in that part of the ring which crossed the globe.

I shall be very glad to receive notes of other observations of Saturn made on July 17, and shortly before and after that date.

Invermay, Leeds, July 21. C. T. WHITMELL.

THE ELECTRIFICATION OF LONDON.

THE various electric railway Bills which have already passed through the House of Lords came up for second reading in the House of Commons last week. In spite of some attempts to reject several of these Bills they all successfully passed the second reading and have been referred to two Select Committees of the House of Commons. These Committees, each of which will deal with about half-a-dozen Bills, are to hold their first meetings at once, the one under the chairmanship of Sir L. M'Iver, the chairman of the other being Mr. Seale-Hayne.

The Bills have already been thoroughly investigated by the Select Committees of the House of Lords presided over by Lord Windsor and Lord Ribblesdale during April and May. These two Committees had much the more arduous task, as they had to deal with a larger number of Bills, several of which they rejected. It is possible, as a result of their work, to form some idea of